There are many user-adjustable input assumptions in the Wire Center module. The following sections discuss these assumptions, and Appendix B includes additional tables showing all of the default values for the module's input parameters.

a) Traffic Assumptions

Many of the calculations in the Wire Center module rely on traffic assumptions suggested in Bellcore documents.[29] These inputs, which the user may alter, assume 1.3 busy hour call attempts (BHCA) per residential line and 3.5 BHCA per business line. Total busy hour usage is then determined based on published Dial Equipment Minutes (DEM) information. Other inputs, which may be changed by the user, specify the fraction of traffic that is interoffice, the fraction of traffic that flows to operator services, the local fraction of overall traffic, as well as breakdowns between direct-routed and tandem-routed local, intraLATA toll, and access traffic. Appendix B contains tables showing the default settings for these parameters.

3. Explanation of calculations

The following sections describe the calculations used to generate investments associated with switching, wire centers, interoffice transport, signaling and operator systems functions.

a). End office switching investment calculations

The Module places at least one end office switch in each wire center. It sizes the switches placed in the wire center by adding up all the switched lines in the CBGs served by the wire center, applying a user-adjustable administrative line fill factor, and then comparing the resulting line total to the maximum allowable switch line size. The maximum switch line size parameter is user-adjustable, but its default setting is 80,000 lines. The model will equip the wire center with a single switch if the number of ports (lines

[29] Bell Communications Research, *LATA Switching Systems Generic Requirements, Section 17: Traffic Capacity and Environment*, TR-TSY-000517, Issue 3, March 1989.

and trunks) served by the wire center is no greater than 80,000. If a wire center must serve 90,000 lines, the model will compute the investment required for two 45,000 line switches.[30]

The wire center module performs two additional capacity checks. First, it compares the BHCA produced by the mix of lines served by each switch with a user-adjustable processor capacity (default set at a maximum of 600,000 BHCA, depending on the size of the switch) to determine whether the switch is line-limited or processor real-time-limited. In making this calculation, the per-line BHCA input is multiplied by a user-adjustable processor feature loading multiplier. The default value of the feature loading multiplier varies between 1.2 and 2.0, depending on business line penetration, to reflect additional processing loads caused by features.

Second, the module compares the offered traffic, expressed as BHCCSs, with a user-adjustable traffic capacity limit (default set at a maximum of 1,800,000 BHCCS, depending on the size of the switch). To make this comparision, the per-line traffic estimates calculated from the reported DEMs is multiplied by a user-adjustable holding time multiplier, which can be separately set for business and residence customers. Default values of the business and residential holding time multipliers are 1. They can be increased above that value to reflect calls that have longer than normal holding times that increase the traffic load on the switch; an example might be the onset of heavy Internet access via the voice network.

If either of these tests leads to the corresponding capacity limit is being exceeded, the model will compute the investment required for additional switches, each serving an equal number of total lines.

Once the model determines the end office switch line size, it calculates the required investment per line from an investment function that relates per-line switching investment to switch line size. The investment function has been refined in HM 3.0. It reflects economies of scale in switching costs that result in decreasing switch cost per line as the size of switch increases. It also accounts for lower equipment prices negotiated by large volume purchasers of switching equipment, such as the RBOCs and other large local exchange companies. Accordingly, the model uses two switching cost curves, one for large telephone companies and one for small independent telephone companies (ICOs). Both curves reflect the decreasing cost of switching per line as a function of switch size.

[30] If multiple switches are required in the wire center, they are sized equally to allow for maximum growth on both switches.

The switching cost curves were developed using switching cost averages from the Northern Business Information (NBI) publication, "U.S., Central Office Equipment Market: 1995 Database,"[31] in conjunction with public line and switch data from the ARMIS 43-07 and the USF NOI data request from 1994 containing 1993 data.

The large telephone company curve uses the RBOC and GTE average switching costs per line reported in the NBI study. These two switching cost points were paired with the average sizes of current RBOC and GTE switches derived from 1995 ARMIS 43-07 line and switch data. A third cost point for large switches of 80,000 lines was developed from other industry sources. A logarithmic curve was then fit to these data using least-squares regression. As demonstrated in figure 9, this functional form fits the data very closely.

The 1993 USF NOI data was used to estimate an average line size for small LEC switches. A 1995 average line size was estimated by assuming the ICOs have experienced growth in average lines per switch between 1993 and 1995 similar to that experienced by GTE. The value on the large LEC curve corresponding to this 1995 small LEC average line size was compared to the ICO per line value from the NBI report. This produced a 1.7 factor which was applied to the constant term in the logarithmic functional form to produce a curve of similar shape, but shifted upward compared to the large LEC curve.

The per-line investment figures from the NBI study are for the entire end office switch, including trunk ports. The investment figures are then reduced by $16 per line to remove trunk port investment based on a line to trunk ratio of 6:1. The actual number of trunks per wire center is calculated in the transport calculation, and the investments for these trunks are then added back into the switching investments. Figure 9 shows the switching investment curves for large LECs representing this methodology.

[31] Northern Business Information study: U.S. Central Office Equipment Market -- 1995, McGraw-Hill, New York , 1996

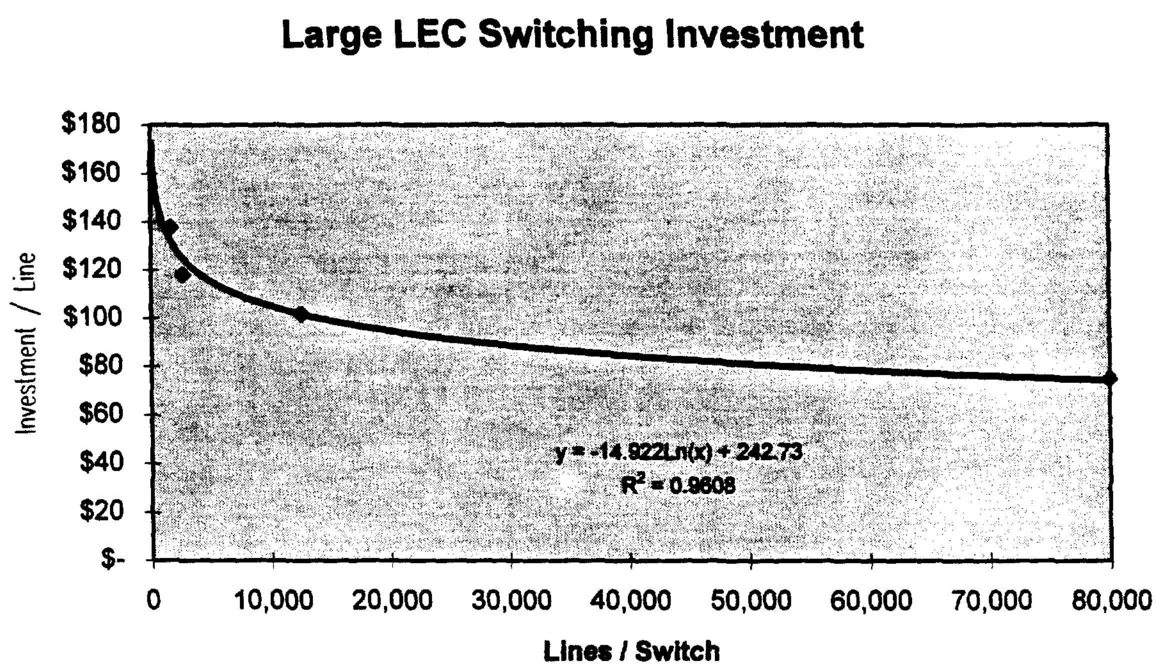


Figure 9 Switching investment curve

Wire center investments required to support end office and tandem switches are based on assumptions regarding the size of room required to house a switch (for end offices, this size varies according to the line sizes of the switch), construction costs, lot sizes, land acquisition costs and investment in power systems and distributing frames. The default values are shown in Appendix B.

The model computes required wire center investments separately for each switch. For wire centers housing multiple end office switches, the wire center investment calculation adds switch rooms to house each additional switch.

b). Transport calculations

A preprocessing step, relying on licensed LERG data, produces end office-to-tandem, end office-to-STP, tandem-to-STP, and STP-to-STP distances in a table that then is used by the module to estimate interoffice transmission facility investments.

The traffic and routing assumptions listed above, along with the total mix of access lines served by each switch, form the basis for the model's transport calculations. The model determines the overall breakdown of traffic per subscriber according to the given traffic assumptions and computes the numbers of trunks required to carry this traffic. These calculations are based on the fractions of total traffic assumed for interoffice, local direct routing, local tandem routing, intraLATA direct and tandem routing, and access dedicated and tandem routing. These traffic fractions are applied to the total traffic generated in each wire center according to the mix of business and residential lines and appropriate per-line offered load assumptions. These trunk loading assumptions include a user-adjustable maximum trunk utilization of 27.5 CCS in the busy hour.[32]

HM3.0 uses a substantially different interoffice transport configuration, and correspondingly different transport distance calculations, than HM2.2.2. HM R3.0 assumes that, with some exceptions, all interoffice facilities take the form of a set of interconnected OC-48 Synchronous Optical Network (SONET) fiber rings. The rings are assumed to pass through each wire center, and are interconnected at tandem offices and at one end office in any town containing multiple end offices but no tandem switches. At each end office switch, the investment in transmission equipment includes sufficient add/drop multiplexers (ADMs), terminal multiplexers (to provide interfaces to end office and tandem switches at the DS-1 level, and DSX panels to support the number of trunks that terminate in that wire center's switch or switches. It also includes channel banks for multiplexing voice-grade and unmultiplexed digital special access lines in cases where special access lines are not carried by digital loop carrier in the feeder portion of the network. In offices where the SONET rings are assumed to interconnect, the model equips the offices with multiple ADMs.

It is not necessary to specify which offices are connected to a given ring in the model. However, on the basis that each office is on a ring, the model calculates an effective distance the ring must traverse to link each wire center. It does this by 1) adding the areas of all the CBGs served by a wire center to arrive at an estimate of the total area served by the wire center; 2) calculating the square root of the area to arrive at the length of a side of the serving area, considering the area to be a square; and 3) calculating the ring route across the serving area as 1.5 times the length of the side. The extra 50% accounts for the fact that the route is unlikely to be a straight line across the wire center area. The model also checks to determine whether twice the

[32] The 27.5 CCS value is based on an AT&T estimate of maximum per trunk utilization. See, AT&T Capacity Cost Study.

distance from the wire center to its assigned tandem is less than the distance calculated above; if so, it assumes that routing is physically via the tandem as an alternative to being across the serving area, and thus estimates the route miles as twice the tandem distance.

Because the SONET ring architecture is most efficient when serving high traffic wire centers, the model tests for very small wire centers that would be better served by lower-capacity, less expensive technology. The threshold is set at 5,000 lines. For such offices, it assigns an OC-3 terminal multiplexer of sufficient capacity for that office's traffic, assuming the office will simply terminate all circuits on this the transmission facility, rather than dropping/adding circuits to a fiber ring via ADMs. It then assumes a point-to-point trunk to the tandem switch along a right angle route, similar to the scenario for routing feeder cable between the wire center and SAI for each CBG.

Once the model determines the requisite amount of fiber optic cable, it calculates the costs of installed cable and structure based on user-definable inputs for cable costs, structure costs and configurations (e.g., pullbox spacing), the mix of different structure types, and the amount of structure sharing between interoffice and feeder plant. To account for structure sharing, the model determines the smaller of the investment in feeder and the investment in interoffice facilities, and applies the user-specified percentage sharing to the smaller value to calculate the amount of shared structure investment. The model then subtracts this amount of investment from both the interoffice and feeder investment, and then reallocates one-half of this amount to each. It does this separately for underground, buried, and aerial structure.

Interexchange access facilities require additional treatment, because interexchange carrier POPs may not be located on LEC fiber rings. Thus, dedicated entrance facilities must be engineered. It is not possible to compute the route miles between serving wire centers (or tandems) and IXC POPs to size the lengths of these entrance facilities, because in general the locations of IXC POPs are not publicly available. Therefore, the average distances for IXC entrance facilities is user-adjustable, with a default value of 0.5 miles from its serving wire center.

c) Tandem switch calculations

Tandem and operator tandem switching investments are computed according to assumptions contained in an AT&T report on interexchange capacity expansion costs filed with the FCC.[33] The investment calculation assigns a price to switch "common equipment," switching matrix and control structure, and adds to these amounts the investment in trunk interfaces. The numbers of trunks and their related investments, are derived from the transport calculations described above.

The module scales the investment in tandem switch common equipment according to the total number of tandem trunks computed for the study area. By doing so, it avoids equipping maximum-capacity tandems whenever a LATA is served by multiple tandems. The calculations also recognize that a significant fraction of tandems in practice are "Class 4/5" offices that serve both tandem and end office functions. The amount of sharing assumed is user-adjustable, with a default value of 40%. Tandem wire center calculations assume the maximum switch room size, and further assume the tandem will reside in a wire center that contains at least one end office switch.

d). Signaling network calculations

The Module computes signaling link investment for STP to end office and tandem A links, C links between the STPs in a mated pair, and D link segments assuming the links are carried on the interoffice rings. The investment per link mile is the same as the computed per-DS-0 investment described above.

The model always equips at least two signaling links per switch. It also computes required SS7 message traffic according to the call type and traffic assumptions described earlier. User inputs define the number and length of ISDN User Part (ISUP) messages required for interoffice calls. Default values are six messages per interoffice call attempt with twenty-five octets per message. These values are derived from the AT&T Capacity Cost Study.

Other inputs define the number and length of Transaction Capabilities Application Part (TCAP) messages required for database lookups, along with the percentage of calls requiring TCAP message generation. Default values, also obtained from the AT&T Capacity Cost Study, are two messages per transaction, at 100 octets per message, and 10% of all calls requiring TCAP generation. If the message traffic from a given switch exceeds the link

[33] AT&T, "An Updated study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," filed with the FCC in CC Docket No. 79-252, April 24, 1995 ("AT&T Capacity Cost Study").

capacity (also user-adjustable and set at 56 kbps and 40% occupancy as default values), the model will add links to carry the computed message load. The total link distance calculation includes all the links required by a given switch.

STP capacity is expressed as the total number of signaling links each STP in a mated pair can terminate (default value is 720 with an 80% fill factor). The maximum investment per STP pair is set at $5 million, and may be changed by the user. These default values derive from the AT&T Capacity Cost Study. The STP calculation scales this investment based on the number of links the model requires to be engineered for the study area.

SCP investment is expressed in terms of dollars of investment per transaction per second. The transaction calculation is based on the fraction of calls requiring TCAP message generation, The total TCAP message rate in each LATA is then used to determine the total SCP investment. The default SCP investment is $20,000 per transaction per second and is based on a number reported in the AT&T Capacity Cost Study.

e) Operator systems calculations

Operator tandem and trunk requirements are based on the operator traffic fraction inserted by the user into the model and on the overall maximum trunk occupancy value of 27.5 CCS discussed above. Operator tandem investment assumptions are the same as for local tandems.

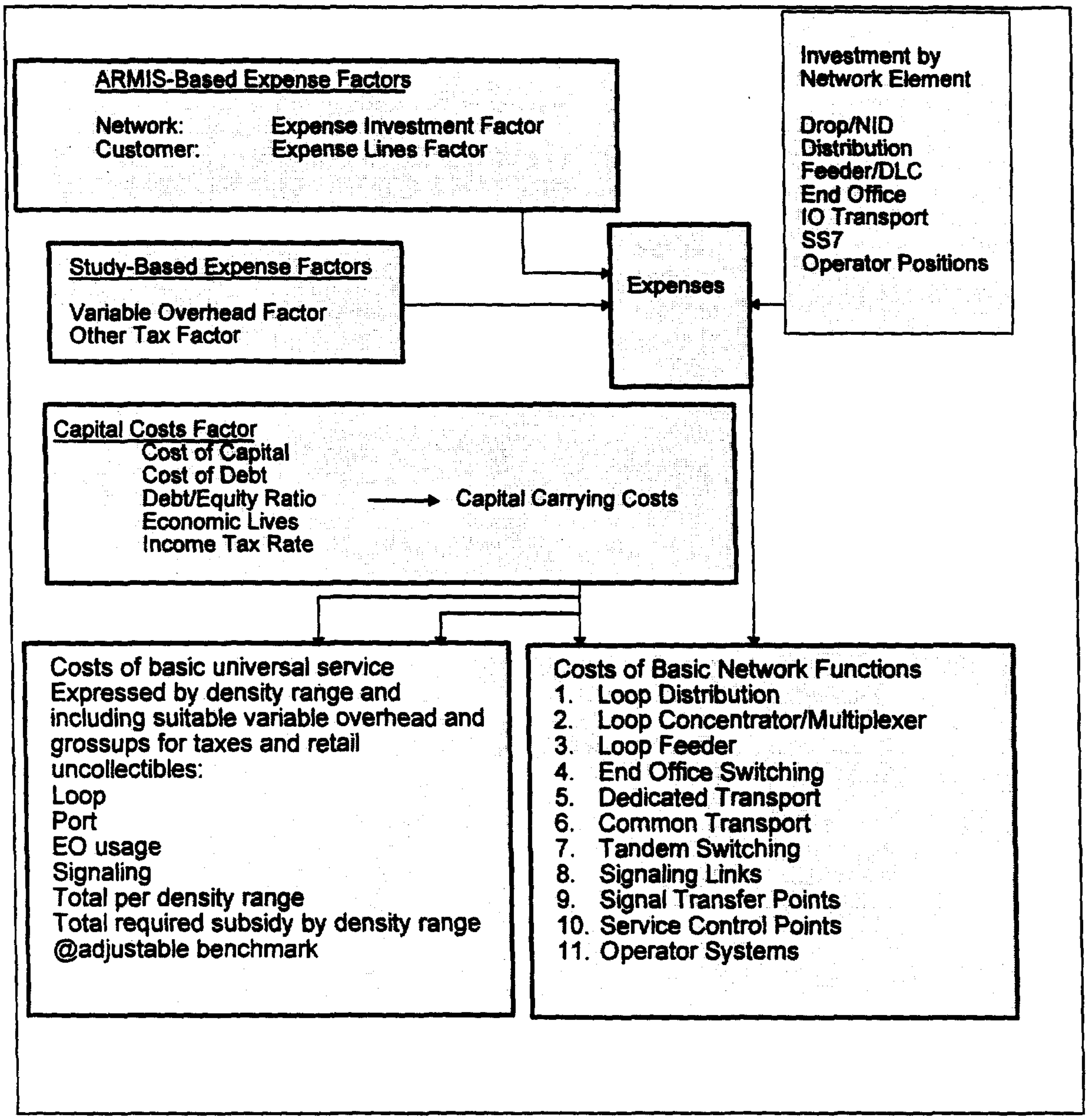
Operator positions are assumed to be based on current personal computer terminal technology. The default operator position investment is $6,400. The Model includes assumptions for maximum operator "occupancy" expressed in CCS. The default assumption is that each position supports 32 CCS of traffic in the busy hour. Also, because many operator services traditionally handled by human operators may now be served by announcement sets and voice response systems, the model includes a "human intervention" factor that reflects the fraction of calls that require human operator assistance. The default factor is 10, which is believed to be a conservative estimate. (A factor of ten implies that one out of ten calls will require human intervention).

F. EXPENSE MODULE

1. Overview

At this point in the model, the network investments necessary to provide UNEs, carrier access, and basic universal service in each study area have been estimated. The capital carrying costs associated with the investments as well as the costs of operating this network are estimated in the Expense Module. Capital carrying costs include depreciation, return on the debt and equity investment required to build the network and a gross-up to pay for the income taxes imposed on equity returns. Network related operating expenses include maintenance and network operations. Non-network related operating expenses include customer operations expenses, general support expenses, other taxes, uncollectibles and variable overhead expenses.

Estimating forward-looking capital carrying costs is relatively straight-forward. The FCC and state regulators have developed standard practices that are based on sound economics to perform this function. Estimating LEC operating costs is more difficult. Few publicly available forward-looking cost studies are available from the ILECs. Consequently, many of the operating cost estimates developed here must rely on relationships to and within historical ILEC cost information as a point of departure for estimating forward-looking operating costs. HAI analysis has determined that while certain of these costs are linked to the number of lines provided by the ILEC, other categories of operating expenses are related more closely to the levels of their related investments. For this reason, the Expense Module develops factors for numerous expense categories and applies these factors both against investment levels and demand quantities (as appropriate) generated by previous modules.



2. Estimation of Capital Carrying Costs

Capital carrying costs are estimated using standard financial techniques. The model calculates annual capital cost for each UNE component based on plant investment for that component from the relevant investment Modules, the return to the net asset, an income tax gross-up on the return to the net asset, and the expected service life (depreciation) of the component. Each of these elements of the capital carrying cost estimate is discussed below.

The weighted average cost of capital (return) is built-up from several components. A 45/55 debt/equity ratio is assumed, with a cost of debt of 7.7 percent and a cost of equity of 11.9 percent, for an overall weighted average cost of capital of 10.01 percent. The equity component of the return is subject to federal, state and local income tax. As a consequence, it is necessary to increase the pre-tax return dollars, so that the after-tax return is equal to the assumed cost of capital. An assumed combined 40 percent federal, state and local income tax (FSLIT) rate was used to "gross up" return dollars to achieve this result.

The model assumes straight-line depreciation and calculates return on investment, tax gross-up and depreciation expenses annually on the mid-year value of the investment. Because capital carrying costs are levelized, substitution of nonlinear or accelerated depreciation schedules for straight-line depreciation would have almost no net effect on calculated annual capital carrying costs. Default values for the service lives of the 23 categories of equipment used in the Model are based on their average projection lives (adjusted for net salvage value) determined by the three-way meetings (FCC, State Commission, ILEC) for the RBOCs and SNET. The table below shows the plant categories and their service lives.

Service Lives for Various Plant Categories

Account	USOA Category	Adjusted Projection Lives (years)
2112	Motor Vehicles	9.16
2115	Garage Work Equipment	11.47
2116	Other Work Equipment	13.22
2121	Buildings	48.99
2122	Furniture	16.56
2123.1	Office Support Equipment	11.25
2123.2	Company Comm Equipment	7.59
2124	Computers	6.24
2212	Digital Switching	16.54
2220	Operator Systems	9.94
2232.2	Digital Circuit Equipment	10.09
2351	Public Telephone	8.01
	NID, SAI	12.00
2411	Poles	16.13
2421-m	Aerial Cable - Metallic	16.80
2421-nm	Aerial Cable - Non-Metallic	22.11
2422-m	Underground - Metallic	21.17
2422-nm	Underground - Non-Metallic	22.87
2423-m	Buried - Metallic	19.86
2423-nm	Buried - Non-Metallic	24.13

2426-m	Intrabuilding - Metallic	15.64
2426-nm	Intrabuilding - Non-Metallic	23.65
2441	Conduit Systems	51.35
	Average Non-Metallic Cable	23.33

Return is earned only on net capital. But because depreciation results in a declining value of plant in each year, thus the return amount declines over the service life of the plant. To ensure that a meaningful long run capital carrying cost is calculated, the return amount is levelized over the assumed life of the investment using net present value factors. An annual capital carrying charge factor is developed for economic depreciation lives from 1 to 60 years. (*see*, "CCCFactor" worksheet in the Expense Module). These factors (which are also disaggregated into their depreciation, return and tax components) are then applied to investment in each plant category (with interpolation to account for fractional values for economic life) to determine the annual capital carrying cost for each plant category.

3. Operating Expenses

The operating expenses can be divided into two categories -- network related and non-network related. Network-related expenses include the cost of operating and maintaining the network, while non-network expenses include customer operations and variable overhead.

The cost categories contained in the FCC's Uniform System of Accounts ("USOA") are used as the point of departure for estimating the operating expenses associated with providing UNEs, basic universal service and carrier access and interconnnection. The major expense categories in the USOA are Plant Specific Operations Expense, Plant Non-Specific Operations Expense, Customer Operations Expense and Corporate Operations Expense. The first two are network-related.

LECs report historical expense information for each of these major categories through the FCC's ARMIS program. The ARMIS data used in the Expense Module include investment and operating expenses and revenues for a given local carrier and state. As noted above, forward-looking expense information for these categories is not publicly available from the ILECs. A variety of approaches are used to estimate the forward-looking expenses.

a) Network-Related Expenses

The two major categories under which network related expenses are reported by the ILECs are plant-specific operations expenses and non plant-specific operations expenses. The plant-specific expenses are primarily maintenance expenses. Certain expenses, particularly those for network maintenance, are strong functions of their associated capital investments. The Expense Module estimates these from historic expense ratios calculated from balance sheet and expense account information reported in each carrier's ARMIS report. These expense ratios are applied to the investments developed by the Distribution, Feeder, and Switching and Interoffice Modules to derive associated operating expense amounts. The ARMIS information used to perform these functions is contained in the "ARMIS inputs" worksheet, and the expense factors are computed in the "'95 Actuals" worksheet of the Expense Module.

Other expenses, such as network operations, vary more directly with the number of lines provisioned by the ILEC rather than its capital investment. Thus, expenses for these elements are calculated in proportion to the number of access lines supported.

The Expense Module estimates direct network-related expenses for all of the UNEs. These operating expenses are added to the annual capital carrying cost to determine the total expenses associated with each UNE. Each network-related expense is described below:

Network Support -- This category includes the expenses associated with motor vehicles, aircraft, special purpose vehicles, garage and other work equipment.

Central Office Switching -- This includes end office and tandem switching as well as equipment expenses.

Central Office Transmission -- This includes circuit equipment expenses applied to transport investment.

Cable and Wire -- This category includes expenses associated with poles, aerial cable, underground/buried cable and conduit systems. This expense varies directly with capital investment.

Network Operations -- The Network Operations category includes power, provisioning, engineering and network administration expenses.

The Expense Module uses specific forward-looking expense factors for digital switching and for central office transmission equipment; these values derive from a New England Telephone cost study.[34] The Module similarly computes a forward-looking Network Operations value based on the corresponding ARMIS value. The total Network Operations expense is strongly line-dependent. The model thus computes this expense as a per-line additive value based on the reported total Network Operations expense divided by the number of access lines and deducting 50 percent of the resulting quotient to produce a forward-looking estimate.

b) Non-Network-Related Operating Expenses and Expense Factors

The Expense Module assigns non-network related expenses to each density range, census block group, or wire center (depending on the unit of analysis chosen) based on the proportion of direct expenses (network expenses and capital carrying costs) for that unit of analysis to total expenses in each category. Each of these expenses is described below:

Variable support -- Certain costs that vary with the size of the firm, and therefore do not meet economic definition of a pure overhead, are often included under the classification of General and Administrative expenses. For example, if an LEC did not provide loops, it would be a much smaller company, and would therefore have lower costs. Some of these costs are nonetheless attributed to overhead under current ILEC accounting procedures. Therefore we include a portion of these "overhead" costs in our TSLRIC estimates. Historical variable support expenses for LECs are substantially higher than those of similar service industries operating in more competitive environments. Based on studies of these variable support expenses in competitive industries such as the interexchange industry, the model applies a conservative 10.4 percent variable support factor to the total costs estimated for unbundled network elements, as well as basic local service.

General Support Equipment -- The module calculates investments for furniture, office equipment, general purpose computers, buildings, motor vehicles, garage work equipment, and other work equipment. The Model uses

[34] New England Telephone, 1993 New Hampshire Incremental Cost Study, Provided in Compliance with New Hampshire Public Utility Commission Order Number 20, 082, Docket 89-010/85-185, March 11, 1991.

actual 1995 company investments to determine the ratio of investments in the above categories to total investment. The ratio is then multiplied by the network investment estimated by the Model to produce the investment in general support equipment. The recurring costs of these items are then calculated in the same way as recurring costs for network investment. A portion of general support costs is assigned to customer operations and corporate operations according to the proportion of operating expense in these categories to total operating expense reported in the ARMIS data. The remainder of costs is then assigned to UNEs.

Uncollectible Revenues -- Revenues are used to calculate the uncollectibles factor. This factor is a ratio of uncollectibles expense to adjusted net revenue. The Module computes both retail and wholesale uncollectibles factors, with the retail factor applied to basic local telephone service monthly costs and the wholesale factor used in the calculation of UNE costs.

4. Outputs of the Expense Module

The Expense Module displays results in a series of reports which depict detailed investments and expenses for each UNE for each density range or wire center, summarized investments and expenses for all UNEs, unit costs by UNE and total annual and monthly network costs. In addition, the UNEs are used to estimate interexchange access costs. The Module also calculates the cost of basic local service per household across density ranges or wire centers.

Basic Network Function (UNE) outputs

The Hatfield Model produces cost estimates for Unbundled Network Elements that are the building blocks for all network services. The UNEs are described below and their inter-relationships are illustrated in Figure 10.

Network Interface Device (NID) -- This is the equipment used to terminate a line at a subscriber's premise. it contains connector blocks and over-voltage protection.

Loop Distribution -- The individual communications channel to the customer premises originating from the DLC remote terminal or SAI and terminating at the customer's premises. In the Hatfield Model, this UNE also includes the investments in NID, drop and terminal/splice.

Loop Concentrator/Multiplexer -- The DLC remote terminal at which individual subscriber traffic is multiplexed and connected to loop distribution for termination at the customer's premises. The Hatfield Model includes DLC equipment and SAI investment in this UNE.

Loop Feeder -- The facilities on which subscriber traffic is carried from the line side of the end office switch to the Loop Concentration facility. The UNE includes copper feeder and fiber feeder cable, plus associated structure investments (poles, conduit, etc.)

End Office Switching -- The facility connecting lines to lines or lines to trunks. The end office represents the first point of switching. As modeled in the Hatfield Model, this UNE includes the end office switching machine investments and associated wire center costs, including distributing frames, power and land and building investments.

Operator Systems -- The systems that process and record special toll calls, public telephone toll calls and other types of calls requiring operator assistance, as well as Directory Assistance. The investments identified in the Hatfield Model for the Operator Systems UNE include the operator position equipment, operator tandem (including required subscriber databases), wire center and operator trunks.

Common Transport -- A switched trunk between two switching systems on which traffic is commingled to include LEC traffic as well as traffic to and from multiple IXCs. These trunks originate at an end office and terminate at a tandem switch. Results are provided on a per-minute basis for the central office terminating equipment associated with the UNE, and for the transmission medium.

Dedicated Transport -- The full-period, bandwidth-specific interoffice transmission path between LEC wire centers and an IXC POP. It provides the ability to send individual and/or multiplexed switched and special services circuits between switches. Results are provided on a per-minute basis and per-channel basis for the central office terminating equipment associated with the UNE, and on a per-minute and per-channel basis for the transmission medium.

Direct Transport -- A switched trunk between two LEC end offices. Results are provided on a per-minute basis for the central office terminating equipment associated with the UNE, and on a per-minute basis for the transmission medium.

Tandem Switching -- The facility that provides the function of connecting trunks to trunks for the purpose of completing inter-switch calls.

Similar types of investments as are included in the End Office Switching UNE are also reflected in the Tandem Switching UNE.

Signaling Links -- Transmission facilities in a signaling network that carry all out-of-band signaling traffic between end office and tandem switches and STPs, between STPs, and between STPs and SCPs. Signaling link investment is developed by the Hatfield Model and assigned to this UNE.

Signal Transfer Point ("STP") -- This facility provides the function of routing TCAP and ISUP messages between network nodes (end offices, tandems and SCPs). The Model estimates STP investment and assigns it to this UNE.

Service Control Point ("SCP") -- The node in the signaling network to which requests for service handling information (*e.g.*, translations for local number portability) are directed and processed. The SCP contains service logic and customer specific information required to process individual requests. Estimated SCP investment is assigned to this UNE.

Universal Service Fund Outputs

The calculation of costs for basic local service is based on the costs of the UNEs constituting this service. These are the loop switch line port, local minute portions of end office and tandem switching, transport facilities for local traffic, and the local portions of signaling costs. In addition, costs associated with retail uncollectibles, variable overheads, and certain other expenses required for basic local service, such as billing and bill inquiry, directory listings, and number portability costs, are included. No operator services or SCP costs are included. The model user has the ability to select dynamically the UNEs (or their fractions) to be included in the supported basic local service.

The USF report in the expense module then compares the monthly cost per line in each density range, CBG or wire center to a user-adjustable "benchmark" monthly price for local service (which include the End User Common Line charge). If the cost exceeds the "benchmark" price, the model accumulates the total required annual subsidy at the stated price level according to the number of households in each density range, CBG, or wire center (depending on the unit of analysis).

Figure 10 Basic Network Functions

IV. SUMMARY

In its Release 3 formulation, the Hatfield Model estimates reliably and consistently both the forward-looking economic cost of unbundled local exchange network elements carrier access and interconnection and the forward-looking economic cost of basic local telephone service. Because both of these calculations are performed in adherence to TELRIC/TSLRIC principles, Hatfield Model cost estimates provide an accurate basis for the efficient pricing of unbundled network elements carrier access and interconnection and the calculation of efficient universal service funding requirements.

Like its predecessor, HM3.0's methodology is open to for public scrutiny. To the extent possible, it uses public source data for its inputs; these default input values represent the developers' best judgments of efficient, forward-looking engineering and economic practices. In addition, because these inputs are adjustable by the users, HM3 can use the model's automated interface to model directly and simply any desired alternative scenario and to conduct sensitivity analyses.

2

TAB 2

Hatfield Model Release 3.0

Appendix A

Data Inputs Development Description

Appendix A

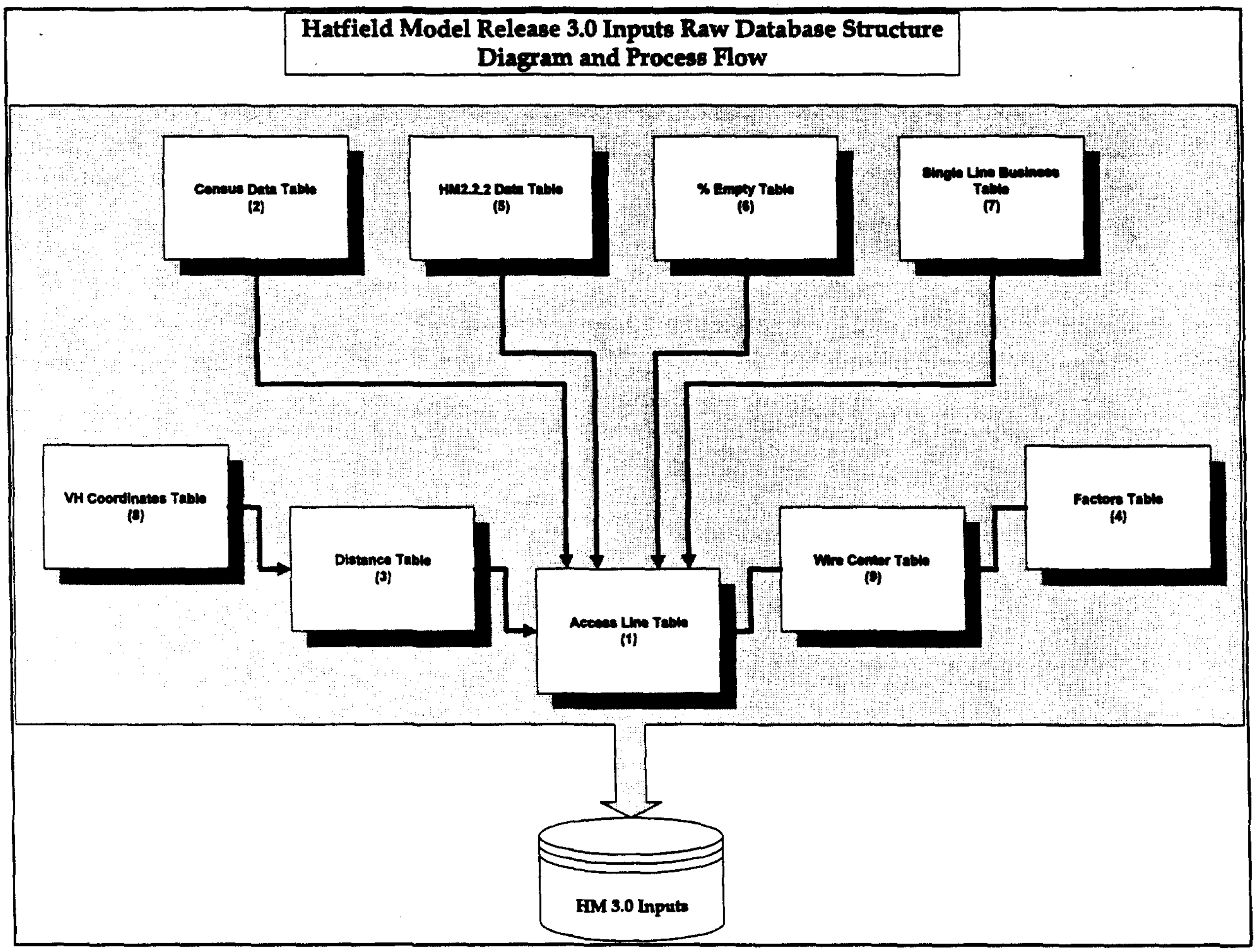
Hatfield Model

Release 3.0

Data Inputs Development Description

I. Raw Database Structure Description

Raw Database Structure Diagram



1. Access Line Table

The Access Line Table is based upon the Wire Center Access Line Model which is a methodology developed by PNR and Associates to allocate access lines to wire centers. This methodology uses PNR survey information, Dun & Bradstreet business establishment information, and Donnelley Marketing household database to estimate the number of residential and business access lines in each Census Block Group (CBG) in the United States, and to map these CBGs to the telephone company wire center that serves them. This summary describes briefly the methodology, data and assumptions used in constructing the access line model.

Residential Access Lines

Using survey results, residential "second" lines are estimated a function of age and income demographic information, by local telephone company and state. The models are projected to the CBG level using U.S. Census Bureau age and income distributions, and to each Census Block (CB) within a CBG using Census household data at the CB level. The number of households for each CB was obtained using 1995 census estimates provided by Claritas and Donnelley household data. PNR considers these 1995 household data to be superior to the estimates of CACI Marketing Systems that were employed in HM2.2.2. The percentage of households without telephones was obtained from the 1990 Census for every CBG. The number of residential access lines within a CB was estimated using household count information, second line penetration and telephone penetration.

The entire Donnelley DQI^2 database of approximately 85 million households was geo-coded with latitude and longitude values and with CB codes. For each CB a correspondence table was created linking CBs to wire centers. Where there are multiple wire centers associated with a CB, the mode wire center was chosen. When the data are complete for all states, the total number of residential access lines at the state level will be constrained to be consistent with the number of residential access lines reported to the FCC in ARMIS.

Business Access Lines

Using business survey results, models of business line penetration were developed including the probability of use of Centrex. The models were based on SIC code, employment size, region of country and legal status. Model results are appended to each firm in the Dun & Bradstreet database.

Firms in the Dun & Bradstreet database are geo-coded and assigned CB codes and latitude and longitude values. Using the CB to wire center correspondence table, the number of access lines of each firm within a CB or CBG were aggregated to obtain an estimate of the total number of business access lines within each wire center. When the data are complete for all states, the total number of business access lines at the state level, including Centrex, will be constrained to be consistent with the number of business access lines reported to the FCC in ARMIS.

Fields:
STATE
CBG
WIRE CENTER
FIRMS
EMPLOYEES
BUSINESS LINES
CENTREX
PENETRATION
HOUSEHOLDS
RESIDENCE LINES

2. Census Data Table

This table contains housing unit types for each group in each CBG. It also contains land and water area measurements for each CBG.

Fields:
CBG
1-HU DETACH
1-HU ATTACH
HU-2
HU-4
HU-5-9
HU 10-19
HU 20-49
HU 50+
MOBILE
OTHER
AREA (SQ MILES)
AREA LAND (1000 KM)
AREA WATER (1000 KM)

3. Distance Table

Through a series of trigonometric calculations, the database produces a table with the radial distance from the wire center location to the centroid of a CBG, with its quadrant, alpha and omega. This information is used to determine the length of feeder facilities necessary to link wire centers to CBGs.

Fields:
CBG
CBG-VERT
CBG-HORIZ
WC VERT
WC HORIZ
CENTROID DIST
ALPHA
OMEGA
QUADRANT

4. Factors Table

The table contains business and residential lines adjustment factors for each company in each state. These values will be applied to the access lines in the access line table in order to normalize all line estimates to ARMIS-reported lines.
If a telephone company does not report ARMIS, its business and residential lines adjustment factors were assumed to match the state-wide average factors calculated for the closest class of ARMIS-reporting LECs.

Fields:
STATE
OCN
COMPANY
BUS FAC
RES FACT
PUB FACT
SPEC FAC
SLB FACT

5. HM2.2.2 Data Table

This table contains Hatfield Model v.2.2.2 wire center to CBG mapping, alpha, omega, quadrant and distance (data which in HM2.2.2 were collected from the BCM-PLUS Model) which on occasion were substituted into the final HM 3.0 dataset.

Fields:
CBG
CLLI
QUAD
OMEGA
ALPHA
DIST
ROCK DEPTH
ROCK HARD
SURF TEXT
WATER DEPTH

6. Percent Empty Table

PNR and Associates provides the percentage of empty land in each CBG. This value is added to the area of water coverage within the CBG (e.g. lakes and rivers) to determine total area empty within a CBG.